April 28, 1936. J. F. KOCH 2,039,089

UNLOADER VALVE

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Fig. 1.

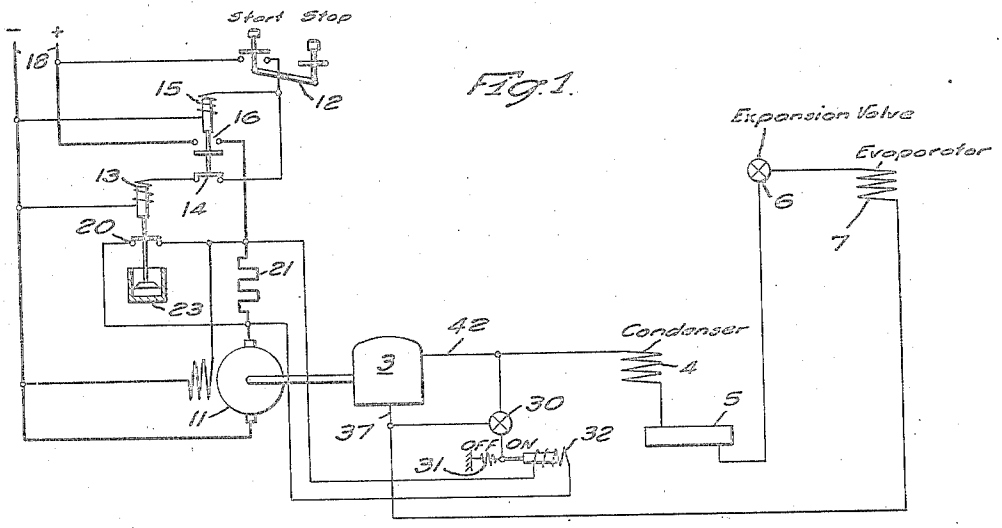
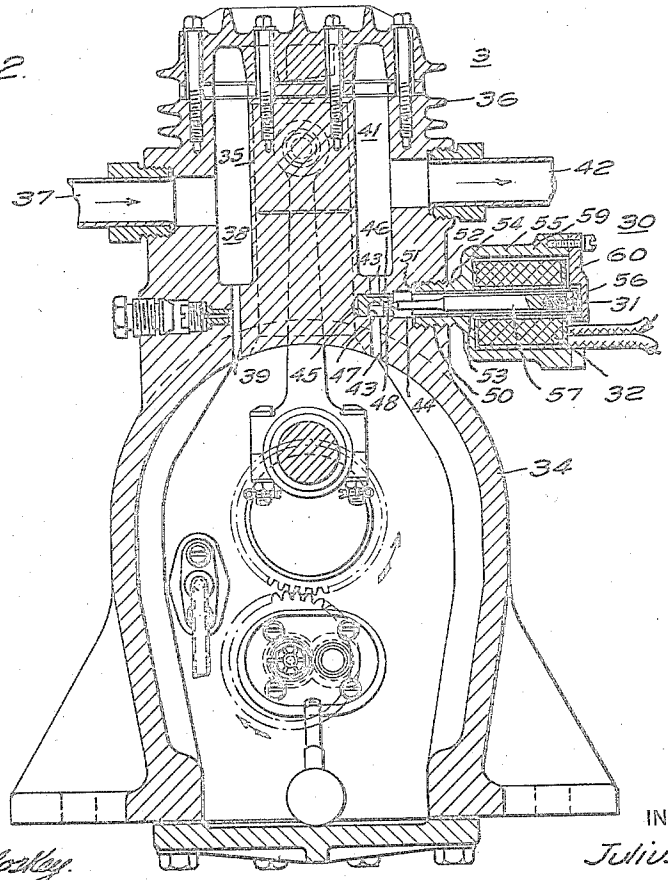


Fig. 2.



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UNLOADER VALVE

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6 Claims. (Cl. 137—139)

My invention relates to pumps or compressors and it has particular reference to a part or combination which I refer to as an unloader valve, which is a spring-closed, magnetically opened valve, preferably mounted on the pump head, for connecting the high-pressure side of the pump to the low-pressure side of the pump when the motor or other prime mover driving the pump is first started up, so as to unload the pump and thus reduce the starting duty on the motor or prime mover.

One of the objects of my invention is to provide a simple construction and a simple arrangement of ducts whereby the aforesaid unloading or by-pass connection may be made between the inlet and outlet sides of the pump, preferably by means of holes drilled directly in the pump head or casing.

A further object of my invention is to provide an unloader valve which has no outside sealed joints, whereby leakage is absolutely prevented.

With the foregoing and other objects in view, my invention consists in the apparatus and combinations hereinafter described and illustrated in the accompanying drawing, wherein

Figure 1 is a diagrammatic view of a refrigerating circuit or cycle in which my invention is applicable, including a compressor which is driven by an electric motor, with a diagrammatic indication of the electrical connections for the motor, and

Fig. 2 is a sectional view through a compressor embodying my unloader valve, which is also shown in section.

My valve, although extremely simple, compact and rugged, is the result of many unsuccessful attempts at designing a satisfactory unloader valve and the culmination of much effort in connection with a refrigeration system designed by Dr. Frank Conrad for the air-conditioning of a railway car. The general refrigerating system is the subject matter of an application of Dr. Conrad, Serial No. 653,516, filed January 25, 1933, on Air conditioning system; assigned to the Westinghouse Electric & Manufacturing Company.

The general refrigerating system is indicated in single-line outline in Figure 1, and comprises a compressor **3** for supplying a vaporizable refrigerant fluid to a condenser **4** and thence to a storage tank **5**, an expansion valve **6**, and an evaporator **7**, back to the compressor.

The compressor is driven by a suitable prime mover shown as an electric motor **11** which is controlled, either manually or automatically, by a start-stop switch or push button **12**, the closure of which first energizes an electromagnetic accelerating switch **13**, through the normally closed back contacts **14** of a main direct-current electro-magnetic contactor **15**, the main contacts **16** of which connect the motor **11** across a direct-current supply-line **18**. The accelerating switch **13** has normally closed contacts **20** which normally by-pass a resistor **21** which is in series with the motor armature. When the accelerating switch **13** is energized, its contacts **20** are quickly broken, thereby inserting the resistance **21** in the motor circuit, and this happens before the main-direct-current contactor **15** closes its main contacts **16** to connect the motor across the direct-current line **18**. The motor thus starts with a starting resistance **21** connected in its circuit.

It will be noted that as soon as the main direct-current contactor **15** picks up, its back contact **14** breaks the energizing circuit of the accelerating relay, but the accelerating relay is provided with a dashpot **23** which is so arranged as to retard the reclosure of this switch, without materially retarding the opening thereof. The accelerating switch, as soon as the motor is started, thus begins to close again, and after a time determined by the dashpot it finally closes its contacts **20** and short circuits the starting resistor **21**.

The particular type of motor or prime mover just described is not essential to my invention, the essential feature being that the compressor is driven by a prime mover of such a type that it is desirable to reduce the load on the prime mover at the moment of starting the same.

In order to "unload" the compressor at the moment of starting of its prime mover, I provide a special design of unloader valve which is designed as an integral part of the compressor, and which is shown diagrammatically in Figure 1 as a valve **30** by-passing the compressor **3**. The valve is shown as being normally held in its "off" position by a spring **31**, and as being movable to its "on" position by an electromagnetic solenoid **32** which is energized in any convenient way from the starting equipment of the electric motor **11**. As is shown in the drawing, the solenoid **32** is energized in shunt to the starting resistor **20**, so that when the starting resistor is in circuit, at the first moment of starting, potential is applied to the electromagnetic valve solenoid **32** so as to open the by-pass valve and materially reduce the load of the compressor on the motor **11**.

Figure 2 shows the mechanical construction and arrangement of the unloader valve **30** as an integral part of the compressor **3**. The compressor is shown as being of the reciprocating type hav-

ing a crank case 34, a piston 35 and a cylinder 36. The compressor is provided with an inlet pipe 37 which is in communication with a hole 38 drilled longitudinally in the side wall of the cylinder 36, said hole 38 being in communication with the crank case 34, through a smaller hole 39. The inside of the crank case 34 thus constitutes the low-pressure side of the pump.

The piston 35 compresses the refrigerant, which enters the inlet 37 as a vapor, and supplies it to the top of the pump whence it is discharged into a second perforation 41 drilled longitudinally in the side wall of the cylinder 36. From the hole 41 the compressed vapor is discharged through an outlet opening 42.

In accordance with my invention, the high-pressure hole or passageway 41 is connected to the low-pressure chamber or crank case 34 by means of a small bore 43 which is intercepted by a larger bore 44 extending transversely from the outside of the cylinder 36. The inner end of the transverse bore 44, which cuts across the longitudinal bore 43, is filled by a plug 45 which is pressed therein, said plug having a lateral groove 46 which connects the upper or high-pressure end of the bore 43 with the outer end of the bore 44, said plug 45 being also provided with communicating lateral and longitudinal bores 47 and 48 which connect the lower, or low pressure, end of the bore 43 with the outer end of the bore 44.

The outer end of the bore 44 is provided with a tapped counterbore 50 providing a shoulder or seat 51 for the flanged end 52 of a tube 53 of non-magnetizable material such as copper. The inner flanged end 52 of the copper tube is sealed against the shoulder 54 by the threaded inner end 54 of a magnetic housing 55 which is screwed into the tapped counterbore portion 50 so as to tightly compress the copper flange 52 against the shoulder 51, making a self-sealing joint for the inner end of the copper tube 53. The outer end of the copper tube 53 is permanently sealed by means of a cap 56 which is welded to the tube.

Disposed within the copper tube 53 is an iron solenoid 57, the outer end of which is pressed inwardly by means of the aforementioned valve-closing spring 31, and the inner end of which is tapered to seat within the longitudinal duct 48 of the plug 45 so as to normally seal the same and to prevent the escape of the high-pressure vapor from the high-pressure chamber to the low-pressure chamber of the compressor.

The magnetizable housing 55 is provided with an enlarged outer end 59 which provides a space for receiving the aforementioned electromagnetic solenoid 32 which lies within this enlarged end, surrounding the copper tube 53, so as to exert a pulling action on the magnetizable armature 57, to open the valve against the pressure of the spring 31, when the solenoid is energized. The outer end of the magnetizable housing 55 may be closed by any suitable cap 60, preferably of magnetic material.

It will be noted that the interior of the copper tube 53 is in communication, at all times, with the high-pressure side of the compressor, and leakage of the compressed fluid is positively prevented by the permanent sealing of the copper flange 52, and by the welded plug 56 in the end of the copper tube. The space in which the solenoid 32 lies is in communication with the atmosphere.

I claim as my invention:

1. An instrumentality comprising a wall having a high-pressure chamber at one end and a low-pressure chamber at the other end, a valve for joining said high-pressure chamber to said low-pressure chamber, said wall having a transverse countersunk bore extending transversely in from one side of the wall, transverse to a longitudinal line between the high- and low-pressure chambers, the countersunk or outer, large portion of said bore being tapped and providing an abutting shoulder, a tubular cap member closed at one end and having an outwardly extending annular flange at the inner end, threaded means for engaging said tapped countersunk portion and clamping said flange against said shoulder, said cap member forming an extension of the inner or smaller portion of said bore comprising a valve chamber extending out laterally from said wall, means for providing a valve seat in the inner end of said bore in said wall, a valve closure-member mounted for axial movement in said valve chamber for engagement with, and disengagement from, said valve-seat, a spring in said chamber for biasing said valve closure-member toward its seated position on said valve-seat, and means for providing smaller communicating passages extending from opposite sides of said valve-seat to the high- and low-pressure chambers, respectively, said means including longitudinal bores through the intervening wall-portions, said longitudinal bores being smaller than, and communicating with, said transverse bore.

2. An instrumentality comprising a wall having a high-pressure chamber at one end and a low-pressure chamber at the other end, a valve for joining said high-pressure chamber to said low-pressure chamber, said wall having a transverse countersunk bore extending transversely in from one side of the wall, transverse to a longitudinal line between the high- and low-pressure chambers, the countersunk or outer, large portion of said bore being tapped and providing an abutting shoulder, a non-magnetizable tubular cap member closed at one end and having an outwardly extending annular flange at the inner end, threaded means for engaging said tapped countersunk portion and clamping said flange against said shoulder, said cap member forming an extension of the inner or smaller portion of said bore comprising a valve-chamber extending out laterally from said wall, means for providing a valve-seat in the inner end of said bore in said wall, a valve closure-member mounted for axial movement in said valve-chamber for engagement with, and disengagement from, said valve-seat, a magnetizable armature associated with said valve closure-member within said valve-chamber, a spring in said chamber for biasing said valve closure-member toward its seated position on said valve-seat, means for providing smaller communicating passages extending from opposite sides of said valve-seat to the high- and low-pressure chambers, respectively, said means including longitudinal bores through the intervening wall-portions, said longitudinal bores being smaller than, and communicating with, said transverse bore, and an electric winding disposed outside of said tubular cap member for causing said armature to move said valve closure-member off of said seat against the pressure of said spring.

3. An instrumentality comprising a wall having a high-pressure chamber at one end and a low-pressure chamber at the other end, a valve for joining said high-pressure chamber to said low-pressure chamber, said wall having a transverse bore extending transversely in from one side of the wall, transverse to a longitudinal line

between the high- and low-pressure chambers, a valve-seat plug member in said bore, a non-magnetizable tubular cap member closed at its outer end, means for tightly securing the inner end of said cap member to said wall in communication with said transverse bore so as to form an extension of said bore comprising a valve chamber extending out laterally from said wall, means for providing a valve-seat in the inner end of said bore in said wall, a valve closure-member mounted for axial movement in said valve-chamber for engagement with, and disengagement from, said valve-seat, a magnetizable armature associated with said valve closure-member within said valve-chamber, a spring in said chamber for biasing said valve closure-member toward its seated position on said valve-seat, means for providing smaller communicating passages extending from opposite sides of said valve-seat to the high- and low-pressure chambers, respectively, said means including longitudinal bores through the intervening wall-portions, said longitudinal bores being smaller than, and communicating with, said transverse bore, and an electric winding disposed outside of said tubular cap member for causing said armature to move said valve closure-member off of said seat against the pressure of said spring.

4. An instrumentality comprising a wall having a high-pressure chamber at one end and a low-pressure chamber at the other end, a valve for joining said high-pressure chamber to said low-pressure chamber, said wall having a transverse countersunk bore extending transversely in from one side of the wall, transverse to a longitudinal line between the high- and low-pressure chambers, the countersunk or outer, large portion of said bore being tapped and providing an abutting shoulder, a non-magnetizable tubular cap member closed at one end and having an outwardly extending annular flange at the inner end, a magnetizable casing having, on its inner end, threaded means for engaging said tapped countersunk portion and clamping said flange against said shoulder, said cap member forming an extension of the inner or smaller portion of said bore comprising a valve chamber extending out laterally from said wall, means for providing a valve-seat in the inner end of said bore in said wall, a valve closure-member mounted for axial movement in said valve-chamber for engagement with, and disengagement from, said valve-seat, a magnetizable armature associated with said valve closure-member within said valve-chamber, a spring in said chamber for biasing said valve closure-member toward its seated position on said valve-seat, means for providing smaller communicating passages extending from opposite sides of said valve-seat to the high- and low-pressure chambers, respectively, said means including longitudinal bores through the intervening wall-portions, said longitudinal bores being smaller than, and communicating with, said transverse bore, and an electric winding disposed outside of said tubular cap member and within said magnetizable casing for causing said armature to move said valve closure-member off of said seat against the pressure of said spring.

5. An instrumentality comprising a wall having a high-pressure chamber at one end and a low-pressure chamber at the other end, a valve for joining said high-pressure chamber to said low-pressure chamber, said wall having a longitudinal bore joining said high- and low-pressure chambers and a larger transverse bore extending in from the outer surface of said wall so as to intersect said longitudinal bore, a valve-seat plug member tightly fitting in the inner end of said transverse bore, said plug member having a longitudinally extending perforation the outer end of which provides a valve-seat, and a transverse perforation extending in from a side of said plug member into communication with said longitudinally extending perforation and so disposed as to be also in substantial alignment with said longitudinal bore, said plug member also having, in the side diametrically opposite to said first-mentioned side, a longitudinal groove communicating with the outer end of said plug member and extending into communication with said longitudinal bore, a cap member for the outer end of said transverse bore, forming with said bore, a valve chamber, a valve closure-member mounted for axial movement in said valve-chamber for engagement with, and disengagement from, said valve-seat, and a spring in said chamber for biasing said valve closure-member toward its seated position on said valve-seat.

6. The combination with a bored member having a longitudinal bore therein substantially parallel to a surface thereof, of a spring-pressed valve for normally blocking the flow of fluid through said longitudinal bore, said bored member having a larger transverse bore extending in from said surface so as to intersect said longitudinal bore, a valve-seat plug member tightly fitting in the inner end of said transverse bore, said plug member having a longitudinally extending perforation the outer end of which provides a valve-seat, and a transverse perforation extending in from a side of said plug member into communication with said longitudinally extending perforation and so disposed as to be also in substantial alignment with said longitudinal bore, said plug member also having, in the side diametrically opposite to said first-mentioned side, a longitudinal groove communicating with the outer end of said plug member and extending into communication with said longitudinal bore, a cap member for the outer end of said transverse bore, forming, with said bore, a valve-chamber, a valve closure-member mounted for axial movement in said valve-chamber for engagement with, and disengagement from, said valve-seat, and a spring in said chamber for biasing said valve closure-member toward its seated position on said valve-seat.

JULIUS F. KOCH.